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REDESCRIPTION OF *ECHINODERES PILOSUS* (KINORHYNCHA: CYCLORHAGIDA)

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Abstract.—*Echinoderes pilosus* Lang is redescribed from a paratypic male and female collected from kelp washed onto a beach at South Georgia Island in the southwestern Atlantic. The presence of lateroventral adhesive tubes on the fourth segment, patterns of cuticular hairs, scars, and sensory spots, and the morphological differences between the sexes are noted. The species is compared with other species having the same spine formula.

Although the phylum Kinorhyncha generally is associated with marine benthic sediment, several species have been found in association with either other invertebrates or plants (mostly algae). *Echinoderes dujardinii* Claparéde, 1863 was discovered in washings of estuarine algae and oysters by the French zoologist Felix Dujardin (1851). In his "Monographie der Echinodera," Zelinka (1928) again reported *E. dujardinii* and added *E. ferrugineus* Zelinka, 1928, several additional juvenile cyclorhagids, and a homolorhagid, *Pycnophyes rugosus* Zelinka, 1928 to the list of algal inhabitants.

Karl Lang (1936) found *P. kielensis* Zelinka, 1928 and *P. flaveolatus* Zelinka, 1928 in "red algae associated with stone and mud"; 13 years later, he described *E. pilosus* Lang, 1949 "from washings of old kelp cast up on shore. S. Georgia. Grytviken." Pallares (1966), apparently studying the plankton associates with red algae along the southeastern coast of Argentina, also found Lang's species. The only other published record of kinorhynchs in association with algae is that of Moore (1973) who found *Campyloderes macquariae* in samples of kelp holdfast fauna from several localities in the British Isles.

The precise relationship between these kinorhynchs and their algal habitat remains a matter of conjecture. Since all of the kinorhynchs reported from algae also are known from sediments, it is most probable that their presence, in most instances, has been a matter of their being washed into intertidal algae or transferred to the algae as it is washed along the sediment.

At the time of its description, *E. pilosus* needed only to be compared with three other species having the same or at least similar spine formula: *E. dujardinii, E. ferrugineus,* and *E. worthingi* Southern, 1914. Since its description, ten additional species with this same spine formula have been described. In the genus *Echinoderes,* the presence or absence of one spine in particular, the lateral spine or adhesive tube on the fourth segment (L-4), is often difficult to determine. In some species such as one most recently described, *E. nybakkeni* Higgins, 1986, it is a robust spine equal to the other lateral spines in its cuticularization as well as dimensions. In others, such as *E. brevicaudatus* Higgins, 1966, it may be smaller and less cuticularized. In *E. bookhouti* Higgins, 1961 and a few others, only a round cuticular scar, possibly a pore, may replace the L-4 spine or adhesive tube. Some species appear to have neither the L-4 spine or any vestige of it. In some cases such as *E. ferrugineus,* the presence of this spine is mentioned in the description (Zelinka 1928) but not shown in the illustration. In other cases such as *E. pilosus,* the L-4 spine was neither mentioned in the description nor indicated

in the illustration (Lang 1949). The apparent absence of the L-4 spine and the exact nature of several other taxonomic characters prompted the re-examination of this species which is the subject of this report.

Suborder Cyclorhagae Zelinka, 1896
Family Echinoderidae Butschli, 1876
Echinoderes Claparéde, 1863
Echinoderes pilosus Lang, 1949
Figs. 1–10

Echinoderes pilosus Lang, 1949:17, fig. 4a, b (type locality: Grytviken, South Georgia Island).—Karling, 1954:189.—Higgins, 1960:88; 1964:491; 1966:518.—Pallares, 1966:103, pl. 1: figs. A–D; pl. 2 (Puerto Deseado to Sorrel, Argentina).—Kozloff, 1972:121.—Schmidt, 1974: 189.—Higgins, 1977a:12; 1977b:353; 1983:9; 1986:267.

Diagnosis.—*Echinoderes* with middorsal spines on segments 6–10, lateral spines on segments 4, 7–12; middorsal spines 36–74 μm long, becoming longer in posterior progression; lateral spines 36–48 μm long; lateral terminal spines 175–184 μm long, 43–46% of trunk length, with serrulate lateral margins; trunk length 400–408 μm (400–460 μm, Lang's data); lateral terminal accessory spine (of female) 55 μm long, 29% of lateral terminal spine; pectinate fringe very fine; perforation sites abundant, pattern distinctive but not well defined, cuticular hairs appear more abundant than perforation sites suggest; trichoscalid plates large ventrally, very small dorsally.

Redescription.—Paratypic adult male (Figs. 1, 2, 5, 6, 8–10) trunk length 408 μm; MSW-8 (maximum sternal width, at segment 8), 84 μm, 20.5% of trunk length; SW (standard width, =sternal width at segment 12), 78 μm, 19.1% of trunk length; cuticle with many hairs, perforation sites not uniformly distinct; posterior margins of trunk segments finely striated with very fine pectinate fringe.

Segment 2 with 16 placids, about 24 μm long, widest posteriorly, narrowest anteriorly; midventral placid wider (22 μm) than others (14 μm); trichoscalid plates of head region (segment 1) overlapping alternate placids, ventral trichoscalid plates larger (12 μm × 15 μm) than dorsal trichoscalid plates (8 μm × 5 μm), modified midventral scalid prominent, 12 μm long, pointed at posterior end, overlapping midventral placid.

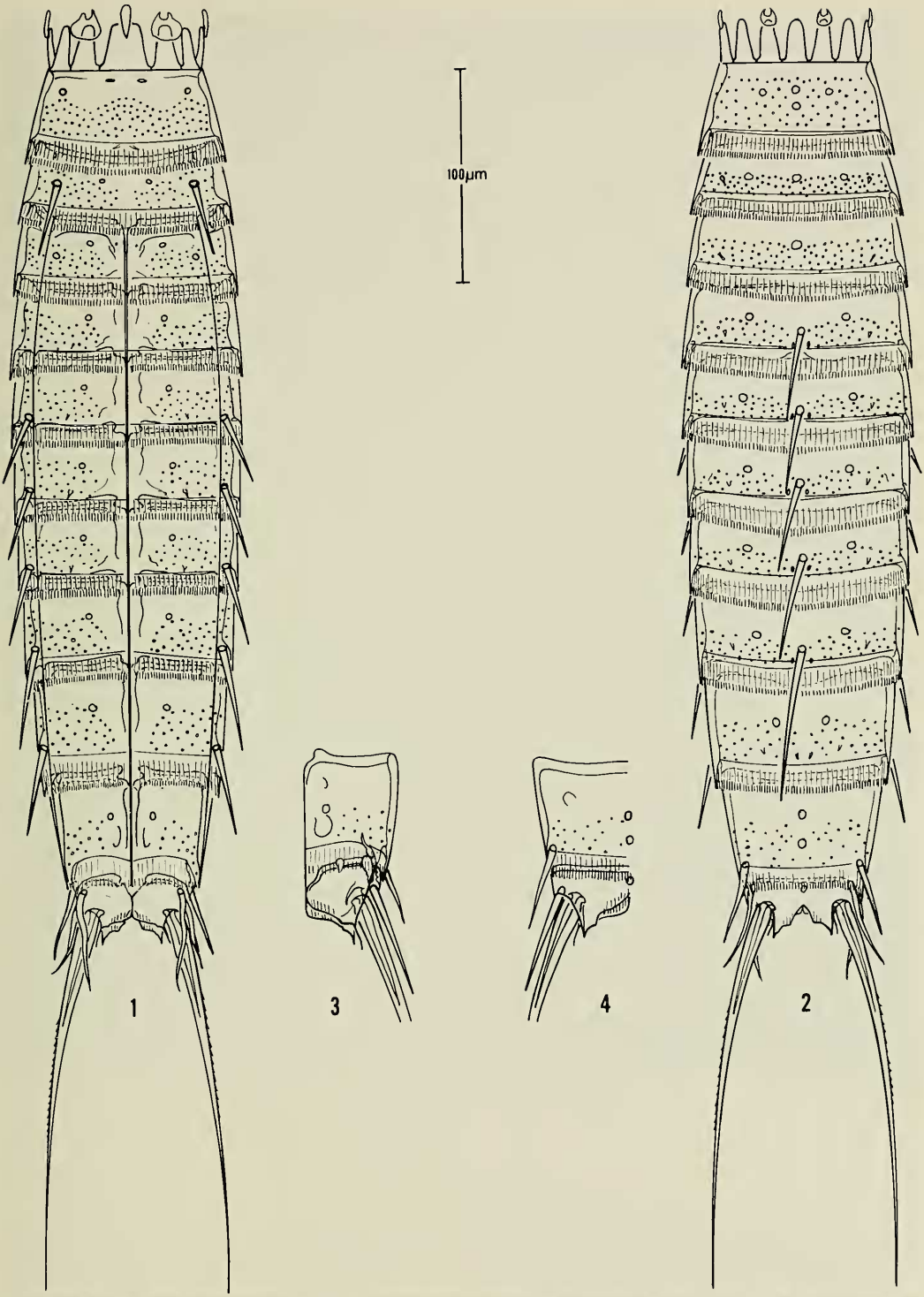
Segment 3, 44 μm long (at lateral optical view); sternal width (measured along anterior pachycycli) 76 μm; two middorsal cuticular scars at midline, subdorsal cuticular scar on either side; single cuticular scar near anterolateral margins on ventral surface.

Segment 4, 42 μm long; pachycyclus moderately developed, no evidence of cuticular thickening along midventral line; middorsal and more lateral (than on segment 3) subdorsal cuticular scars; small angular muscle scar lateral to each dorsolateral cuticular scar; single cuticular scar on either side of ventral midline, near anterior margin; prominent lateral spines (adhesive tubes), 38 μm long, midway in segment, in line with ventrolateral articulation zones of remaining segments.

Segment 5, 44 μm long; sternal width 80 μm; pachycyclus well developed, midventral articulation of sternal plates clearly visible, well cuticularized; middorsal cuticular scar only, small angular muscle scar more lateral, in line with previous scar; single cuticular scar on either side of ventral midline, near anterior margin, additional cuticular scar near each lateral margin of ventral plates.

Segment 6, 48 μm long; sternal width 82 μm; pachycyclus similar to preceding one; middorsal spine, 42 μm long, sensory spots laterally adjacent and slightly posterior to middorsal spine; dorsolateral cuticular scars and small angular muscle scar similar to those of segment 4; cuticular scar near middle of ventral plate, in line with those of previous segments.

Segment 7, 48 μm long; sternal width 83 μm; pachycyclus similar to preceding one;



Figs. 1–4. *Echinoderes pilosus*: 1, Adult male, neck and trunk segments, ventral view; 2, Same, dorsal view; 3, Adult female, segments 12, 13, ventral view; 4, Same, dorsal view.

middorsal spine, 42 μm long, with adjacent sensory spots, cuticular scars and muscle scars as in segment 6; lateral spine 36 μm long (probably adhesive tube) on tergal plate adjacent to junction with each ventral plate; cuticular scar near middle of ventral plate as in previous segment, slight evidence of small angular muscle scar slightly more lateral, near origin of arthrocorium where marginal striation begins.

Segment 8, 50 μm long; maximum sternal width (MSW) 84 μm; middorsal spine, 46 μm long; lateral spine 36 μm long; otherwise similar to segment 7.

Segment 9, 50 μm long; sternal width 84 μm; middorsal spine 50 μm long; lateral spine 40 μm long; otherwise similar to segment 8.

Segment 10, 60 μm long; sternal width 83 μm; middorsal spine 74 μm long; lateral spine 46 μm long; no evidence of small, angular muscle scar on each ventral plate; otherwise similar to segment 9.

Segment 11, 60 μm long; sternal width 80 μm; without middorsal spine; lateral spine 42 μm long; subdorsal cuticular scars closer to midline, small, angular muscle scars less distinct, otherwise dorsal and ventral morphology similar to segment 10.

Segment 12, 61 μm long; SW-12 78 μm; lateral spine 40 μm long, more flexible in appearance than preceding lateral spines, more dorsally elevated on tergal plate; 2 middorsal cuticular scars, no subdorsal cuticular scars or evidence of small, angular muscle scars, perforation sites weak, sparsely distributed near posterior half of segment both dorsally and ventrally; ventral cuticular scars similar to those on preceding segments.

Segment 13, 35 μm long; sternal width 50 μm; lateral terminal spines 175 μm long; serrulate on lateral margins beginning about one-fourth the distance from base; ventral plates with slightly pointed margins, somewhat conforming to margin of tergal plate, with hair-like projection; pachycycli widely divergent at anterior margin; tergal plate with single middorsal cuticular scar, plate bifurcated into two pointed tergal extensions; 3 pairs of penile spines (P-1, 45 μm long, dorsally displaced; P-2, 28 μm long, with blunted tip, ventrolateral; P-3, 50 μm long, adjacent to P-2).

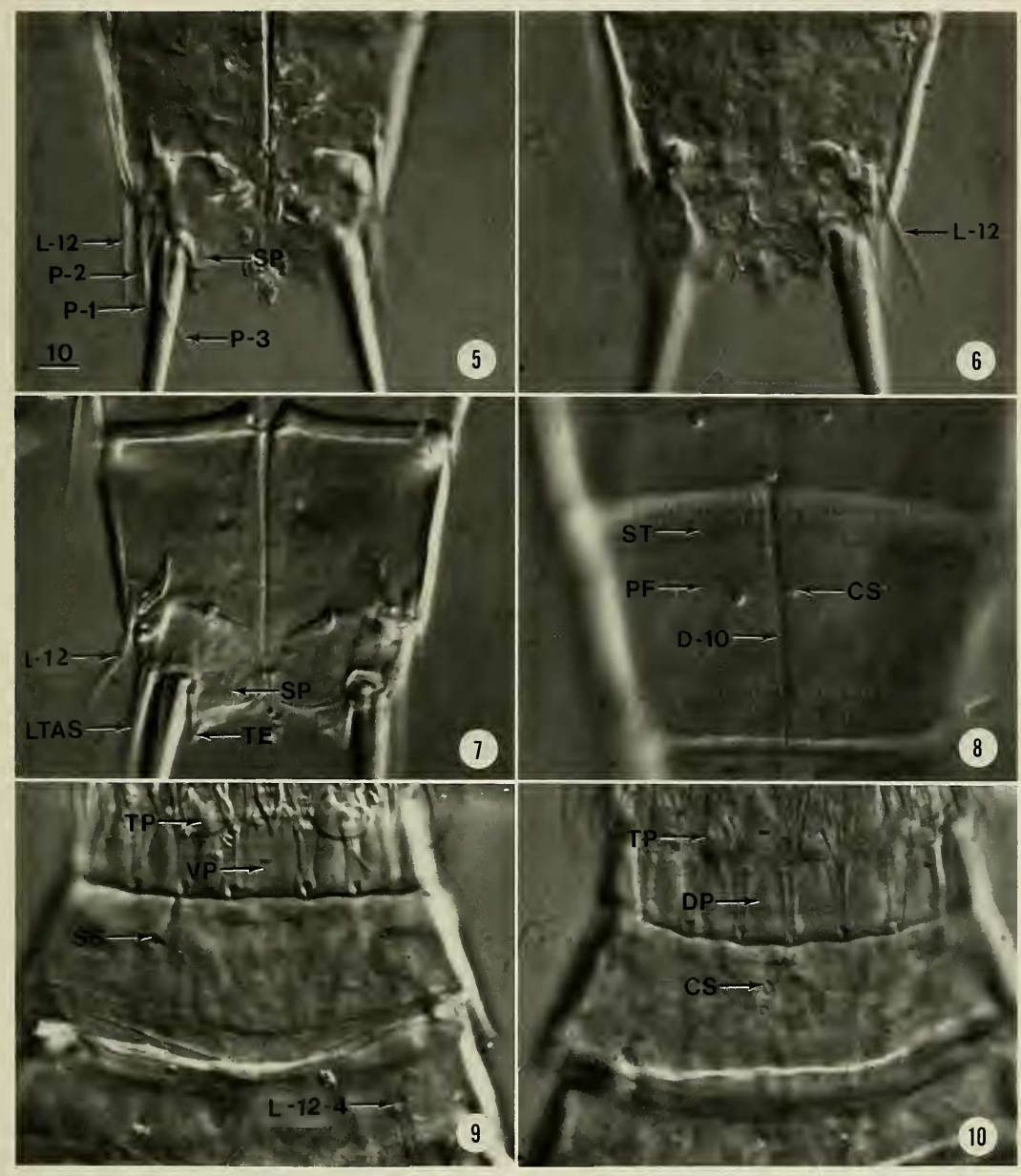
Mean length of middorsal spines (D 6–10) 50.8 μm, 12.5% of trunk length; mean length of lateral spines (L 4, 7–12) 39.7 μm, 9.7% of trunk length.

Paratypic female (Figs. 3, 4, 7) TL about 400 μm (broken specimen); MSW-8 86 μm, 21.5% of trunk length; SW 80 μm, 20.0% of trunk length; middorsal spine lengths: D-6 36 μm, D-7 42 μm, D-8 44 μm, D-9 52 μm, D-10 74 μm; mean length of middorsal spines (D 6–10) 49.6 μm, 12.2% of trunk length; lateral spine lengths: L-4 34 μm, L-7 38 μm, L-8 34 μm, L-9 38 μm, L-10 48 μm, L-11 42 μm, L-12 40 μm; mean length of lateral spines (L 4, 7–12) 39.1 μm, 9.7% of trunk length; lateral terminal spines 184 μm long, 46.0% of trunk length; lateral terminal accessory spines (female only) 54 μm long, 13.5% of trunk length, 29.3% of lateral terminal spine length.

With exception of minor morphological differences in the structure of the last two segments, the female (Figs. 3, 4, 7) closely resembles the male.

Material examined.—1 paratypic male and 1 paratypic female (broken specimen), permanently mounted (by Higgins) in Cobb aluminum slide frames with modified Hoyer's medium (Higgins 1983), material from the Swedish South Pole Expedition (1901–1903), 23 May 1902, Grytviken, South Georgia Island, "Sample 11." Repository: Swedish Natural History Museum (Section of Invertebrate Zoology), Stockholm.

Remarks.—Forty-two species of *Echinoderes* are based on adult specimens and identifiable on the basis of their description. Three others are so poorly described that I consider them species inquirenda; 27 others are based on juvenile states which are not likely to be reconciled with any adult. Within this genus, the most common middorsal



Figs. 5–10. *Echinoderes pilosus*: 5, Adult male, segments 12, 13, ventral view; 6, Same, dorsal view; 7, Adult female, ventral view; 8, Adult male, segments 10 (partial), 11, dorsal view; 9, Same, segments 2–4, ventral view; 10, Same, dorsal view. (Interference contrast photographs.)

spine formula is D 6–10; it is shared by 23 species, 12 of which have lateral spines on segments 4, 7–12. Two of these have an additional lateral accessory spine (LA-10) dorsally adjacent to the L-10 spine and two others differ only by the absence of the L-4 spine or adhesive tube, a character that can be difficult to see. The current re-examination of *E. pilosus,* in large part, was to determine whether or not this spine was ab-

sent as indicated in the original description, or present as has now been established.

Of the 12 species having the same spine formula, *E. dujardinii,* from northern European coasts, and its sibling species, *E. gerardi* Higgins, 1978, from the Mediterranean, have a lateral accessory spine on segment 10 leaving only nine remaining species to compare with *E. pilosus.* The L-4 spine or adhesive tube is not present in either *E. truncatus* Higgins, 1983 or *E. bookhouti,* although the latter species has either a pore or a cuticular scar in the L-4 position.

Several distinctive as well as unique characters in the recently described *E. nybakkeni* separate it from *E. pilosus*; the former species is very small, 185 μm long, has a midventral cuticularization on segment 4, extremely prominent pectinate fringe, and very prominent spines, including a D-7 spine which is twice the length of those on adjacent segments. Similarly, *E. krishnaswamyi* Higgins, 1985 is equally distinctive in having very long, flexible spines and a unique perforation site pattern of one or two transverse rows. This species is the only other with the same spine formula that has serrulate lateral margins on the lateral terminal spines as in *E. pilosus.*

Echinoderes ferrugineus is not as well described as the remaining species closely related to *E. pilosus.* Lang (1949) separated *E. pilosus* from *E. ferrugineus* on the basis of differences "in the size of the 3rd and the shape of the last zonite." *Echinoderes ferrugineus* females, at least, have a prominent seta adjacent to the L-12 spine, and the lateral terminal accessory spine is only 13.5–16.4% of the lateral terminal spine length as contrasted with 29.3% in *E. pilosus.* Although the significance of total length is questionable because of annual variation (Higgins and Fleeger 1980), *E. ferrugineus,* from European coasts, is much smaller (TL 210–220 μm) than *E. pilosus* (TL 400–408 μm; or by Lang's measurements, 400–460 μm). In addition, Lang's species appears to have relatively shorter lateral terminal spines (42.9–46.0% of the trunk length) in contrast with the longer (up to 71% of the trunk length) in *E. ferrugineus.*

Lang also compared his species with *E. worthingi* (redescribed by Higgins 1985). The latter northern European species also is smaller (242–265 μm) than *E. pilosus,* has relatively longer lateral terminal spines (60.3–72.7% of the trunk length), distinctly longer terminal tergal extensions, and a D-10 spine twice the length of the D-9 spine.

Distinctive brace-shaped muscle scars on certain ventral plates of *E. kozloffi* Higgins, 1977, *E. ehlersi* Zelinka, 1913, *E. imperforatus* Higgins, 1983, *E. pacificus* Schmidt, 1974, and *E. sublicarum* Higgins, 1977, separate them from *E. pilosus.*

Echinoderes pilosus has been reported only once since its original description. Pallares (1966) found numerous specimens of this species, including juvenile stages as small as 149 μm long, mostly in various collections of red algae made between 1949–1965 along the southeastern coast of Argentina. Pallares reported the presence of red eyespots in the animals but, like Lang, did not observe the L-4 spines. As in the case of Lang, Pallares' measurements of body length are not defined. Using the standard trunk length measurement (from the anterior margin of the first trunk segment to the posteriormost margin of the last segment) and the measurement scales or other information provided by each of these authors I would suggest that their reported length measurements are excessive. The lengths and relative proportions of various body regions and spines that can be obtained through Pallares' illustrations agree remarkably well with those I have derived from the two paratypes used in the redescription. Similar data derived from Lang's illustrations tend to be much less compatible.

In addition to confirming the presence of the L-4 spine in *E. pilosus,* Lang's (1949) original description requires two additional emendations. His notation on the presence

of "a ring of extremely fine 'hair' quite close to the anterior border of the zonite," refers to the very fine pectinate fringe along the posterior margin of each segment which overlaps the anterior part of the posteriorly adjacent segment. Lang also was in error in his interpretation of placid morphology. Correctly noting the presence of 16 placids comprising segment 2, he stated: "Neither of the two ventro-median placids is perceptibly wider than the others." There is, in *E. pilosus,* as in all known species of this genus, a single midventral placid which is wider than the laterally adjacent placids. In this case, the midventral placid of *E. pilosus* is nearly twice as wide as the others, morphology which also escaped notation by Pallares (1966).

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